An Electric Motor

The present invention relates to an electric motor and more particularly to brush gear for an electric motor.

Brush gear in small electric motors, particular fractional horsepower permanent magnet direct current (PMDC) motors, typically comprises a carbon brush which is carried on an end of a resilient, electrically conducting arm - the brushleaf. The brushleaf is arranged to bias the brush against a commutator on the motor shaft. Typically the brush gear is mounted in an end cap which carries a bearing for the motor shaft and forms a structural part of the motor assembly.

In low voltage applications, the total resistance of the motor becomes more and more determined by the interface resistance between the brushes and the commutator. As the motor resistance determines the maximum power range within which the motor can operate, reducing the brush/commutator interface resistance is very desirable.

According to the invention there is provided an electric motor brush assembly comprising resilient electrically conductive support means arranged to

carry two or more separately formed brush bodies axially displaced with respect to a longitudinal axis of the motor and connected electrically in parallel.

The support means normally comprises a separate arm for each brush body.

The separate arms may be arranged to have different natural resonance frequencies of oscillation.

B The brush bodies may ~~be~~ have different sizes and/or ~~of~~ different physical densities.

A fractional horsepower direct current electric motor may be provided having a brush assembly comprising resilient electrically conductive support means arranged to carry two or more separately formed brush bodies axially displaced with respect to a longitudinal axis of the motor and connected electrically in parallel.

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A fractional horsepower direct current electric motor according to the invention will now be described by way of example with reference to the accompanying

B drawings in which:—

B Figure 1 is an ~~isometric part~~ isometric, partly broken away view of the motor with an end cap removed;

Figure 2 is an end view of the inside of the end cap, showing a brush assembly;

Figure 3 is a sectioned side elevation of Figure 2;

Figure 4 is a top view of the brush assembly;

Figure 5 is a side view of the brush assembly; ~~and~~

Figure 6 shows a different view of part of ~~a brush leaf and a brush~~ the brush assembly of Figure ~~5.~~ 5; and

Referring to the drawings, in Figure 1 the motor has a shaft 10 carrying a wound armature 11 and a circumferentially segmented commutator 12. The commutator 12 is axially longer than commutators of conventional motors of a similar size. A casing 13 has mounted therein two field magnets 14 and an end bearing 15 for supporting the shaft 10.

In Figures 2 and 3, a ~~moulded~~ molded plastic~~s~~ end cap 16 provides a plastic~~s~~ brush holder which supports two pairs of brush arms. Each pair of brush arms consists of a terminal part 17 connected to resilient brush supporting parts or brush leaves 18 and 19. Brushes 20 and 21 are axially displaced with ~~respective~~ respect to the longitudinal axis of the motor and are supported by the free end of respective brush

leaves 18 and 19. The brushes are urged in use into contact with the commutator 12.

In Figures 3 and 4, the terminal part 17 and brush leaves 18 and 19 are fixed together by set of rivots 22 and 23 respectively. Other forms of fixing can be used, such as a clip fixing. The top of the brushes 20 and 21 are shaped (see Figure 6) and are held by interference fits in elongate slots provided in and adjacent the free ends of the brush leaves 18 and 19 respectively.

Embodiments of the invention provide brush assemblies in which two brushes, or more if desired, are mounted side by side and connected electrically in parallel in use. This means that the motor can have a common design but be fitted or altered at the point of assembly to have one brush per brush assembly or two brushes connected in effect in parallel in each assembly. This allows for maximizing ~~maximising~~ of common components for different capacity motors. Where the motor is required for ~~the~~ higher power use, two (or more) brushes are used in the form described in the embodiment.

In modified embodiments, the brush leaves 18 and 19 are formed with different resilient material or somewhat different dimensions so that the respective natural ~~frequency~~ frequencies of oscillations of the brush leaves are

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different. ~~A~~ slot for example may be formed in one of the brush leaves intermediate its ends to reduce its effective resilience. This means that whenever the motor shaft speed corresponds to the resonant frequency of one of the brush leaves, the brush supported by the other leaf will tend to remain in good contact with the commutator. Alternatively, or additionally, the brushes 20 and 21 may be of the same overall dimensions, so that they fit into the same sized elongate slots in the brush leaves, but are formed of different physical density brush material. The brushes may however be formed with different overall sizes for the same purposes and are preferably formed with top parts of the same dimensions to interference fit a common sized slot in the brush leaves.

As mentioned earlier, embodiments of the invention enable the effective interface resistance to be reduced, and allow high currents to be carried for the same winding resistance to provide higher stall torques and currents. As there are two or more brushes, the current density for each brush need not be increased to provide this. Higher current densities normally increase wear, and so reduce the operational lives of the brushes. Further, the dynamic behavior of each brush is different and can be made to be different as explained, so that over a

range of speeds, sound brush contact is maintained without simply increasing brush contact pressure, which in turn would reduce the life of each brush. The inherent deterioration in dynamic behaviour associated with enlarging brushes is also avoided. Dynamic performance is important because the commutators are invariably somewhat imperfect in roundness and rotate at very high speeds in use.